EUROPEAN MECHANICS SOCIETY

Colloquium Final Report

N. 624 – Mechanics of soft active polymers

Dates and location: **24/08/2022 - 26/08/2022, Southampton, UK**

Chairperson **Daniil Yurchenko**

Co-Chairperson **Mikael Lallart, Kostia Volokh**

Conference fees

What other funding was obtained? **registration fees: Students £210 EUROMECH member £210 Non-EUROMECH member £250 Online participants £100 Keynote lectures £0**

What were the participants offered? **The registration fees indluded:**
- The e-book of abstracts.
- Morning refreshment
- Coffee breaks and lunches
- Conference dinner

Number of presentations/registrations:
- 7 students
- 12 Non-Euromech memebers
- 2 Keynote lectures
- 2 Co-chair lectures

Number of members of Euromech (reduced registration fee) **0**

Number of non-members of Euromech (full registration fee) **0**

Scientific Report

Mechanics of soft materials is still one of the major challenges in materials mechanics. Smart soft structures, soft robotics, biomedical devices are developing engineering fields with the great potential of applications of soft materials. Unfortunately, soft materials are a hard scientific subject at the cross-road of condensed matter physics, chemistry and nonlinear mechanics. This symposium highlighted solutions to some problems and raised many new problems to be tackled in the future.

Euromech MSAP (Mechanics of Soft Active Polymers) have demonstrated the requirement of transdisciplinary approaches for efficient energy conversion. This applies to actuation such as:
- Electro-mechanical coupling (“Modeling electro-actuation of polyelectrolyte gels in liquid solution”, “Electromechanical modeling of hydraulically amplified self-healing electrostatic (HASEL) Actuators”)

- Thermo-mechanical coupling (“Experiments and modeling of the thermo-mechanically coupled behavior of VHB””, Effect of thermoelastic coupling on deformation and failure of rubberlike materials”)
- Magneto-mechanical coupling (“On Syntheses and Experimental Characterizations of Magneto-active Polymers”, “Advanced FE framework for magnetoactive polymers including viscoelastic and elastodynamics effects”, “Soft magnetoactive materials: Magneto-deformations and instability-induced pattern Formations”)
- Multiphysic coupling with more than 3 domains (“Investigation on a hybrid electromagnetic-dielectric energy harvester embedded into a Pendulum”)
Additionally to these coupling aspects, the need of taking into consideration the full energy conversion chain has been highlighted. Indeed, the combination of separately optimized substructures is not the most efficient way for obtaining the most efficient device. Such a statement is due to the bidirectional nature of the energy conversion. For instance, a global consideration of the following part is of particular interest for an effective global optimization:
- Material/transducer and structure (“Experiments and modeling of the thermo-mechanically coupled behavior of VHB”, “In-silico characterisation, topology optimisation and design of Electro Active Polymer based soft robots”, “An electromechanical model of fiber-reinforced biological tissues”, “Modeling Viscous phenomena in Liquid Crystal Elastomers”, “Electromechanical modeling of hydraulically amplified self-healing electrostatic (HASEL) Actuators”, “Effect of thermoelastic coupling on deformation and failure of rubberlike materials”)
- Transducer and electrical interface (“Investigation on a hybrid electromagnetic-dielectric energy harvester embedded into a Pendulum”, “Synchronized Switched Electrical Interface for Electrostatic Energy Harvesting using Polymers”)
In particular, the purpose of the targeted device is also of prior importance to this end. For instance, while in the actuation the objective Is to adapt to the load while having a good energy conversion efficiency with respect to the source (for example electrical – “Soft robotic grippers with electroactive contacts”, “3D-Printed Electroactive Polymer Actuator for Optical Shape-Error Correction: The Live-Mirror Approach”, Modeling electro-actuation of polyelectrolyte gels in liquid solution” - or magnetic – “On Syntheses and Experimental Characterizations of Magneto-active Polymers”, “Advanced FE framework for magnetoactive polymers including viscoelastic and elastodynamics effects”, “Soft magnetoactive materials: Magneto-deformations and instability-induced pattern Formations”), energy harvesting necessitates a fine control of the actual extracted and harvested energy whole ensuring that the energy provided by the source is not actually “killed” (“Investigation on a hybrid electromagnetic-dielectric energy harvester embedded into a Pendulum” , “Synchronized Switched Electrical Interface for Electrostatic Energy Harvesting using Polymers”).

Please send this report in electronic form to the Secretary General of EUROMECH, within one month after your Colloquium.